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APPARATUS FOR DETECTING SUSPENDED MATTER IN FLUIDS

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Fig. 1

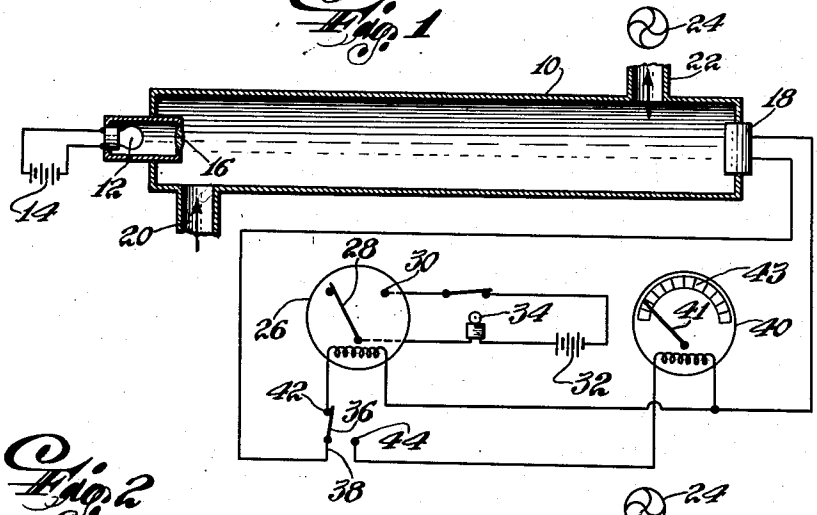


Fig. 2

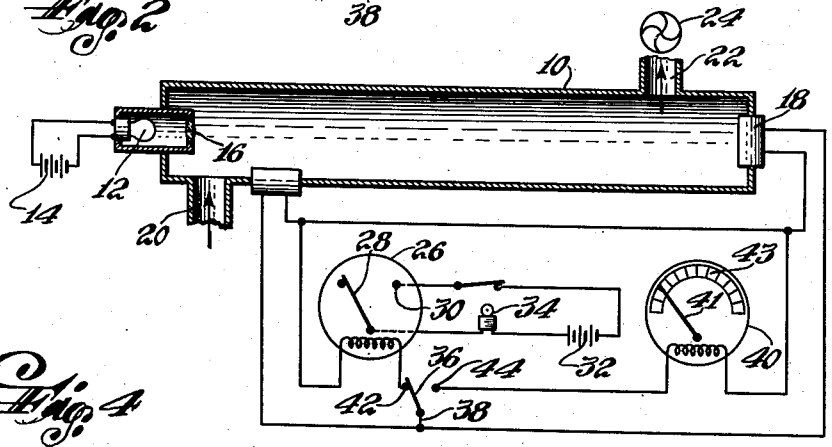


Fig. 4

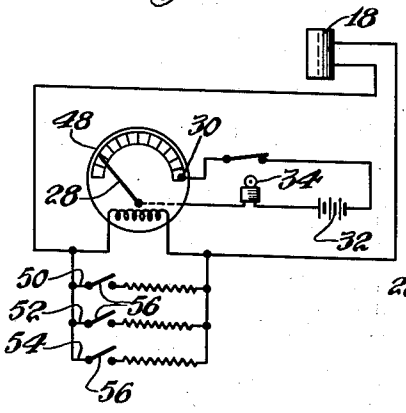
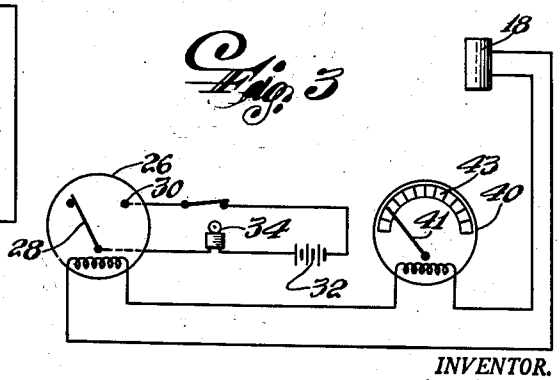


Fig. 3



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APPARATUS FOR DETECTING SUSPENDED MATTER IN FLUIDS

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5 Claims. (Cl. 340—237)

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This invention relates to apparatus for detecting the presence of suspended matter in fluids, and is particularly directed to apparatus for detecting the presence of smoke in air due to the outbreak of fire in a protected space or compartment and for determining the density of the smoke therein.

More specifically, the present invention relates to smoke detectors wherein the presence of smoke in air drawn from a protected space is detected and an alarm given.

The present invention can be utilized with any type smoke detector wherein an electric current changes in value relative to changes in the density of the smoke to be detected. Such detectors include the photoelectric cell types, the thermocouple type, or any other type which depends for its operation upon electric current changes effected by smoke density changes. In some of such types of detectors, the current change results in an increase of the current, while in others the change results in a decrease of the current.

For purposes of illustration and description only, and without limiting the present invention thereto, a photoelectric cell type smoke detector will be referred to herein. In such detectors, the presence of smoke in air drawn from the protected space is detected by the photoelectric cell and an alarm given.

It is known that the concentration of smoke in a compartment in which a fire exists does not remain static, but generally increases as the fire progresses and decreases as the fire subsides, but it is difficult and sometimes impossible to observe the concentration of smoke, and its increase and decrease, in inaccessible compartments and enclosures.

In smoke detectors of the character indicated, such as employed to protect inaccessible compartments in an airplane, air is continuously drawn through a detector tube having a light source at one end and a photoelectric cell at the opposite end in the path of rays of light from the light source. The light rays falling on the photoelectric cell result in the generation of current in the photoelectric cell circuit, which is provided with a relay to effect the giving of an alarm when the intensity of the light rays is decreased. When the air, which is continuously drawn through the detector tube into the path of the light rays, contains smoke, the intensity of the light rays is decreased, whereby the alarm is transmitted to a signal device on the instrument panel of the plane, whereupon the pilot or observer operates

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a fire extinguishing system to discharge fire extinguishing medium into the protected space or compartment.

With such systems, it has been the practice of the pilot or observer to personally inspect the protected space after the discharge of the fire extinguishing medium to determine whether or not the fire has been extinguished. However, in inaccessible spaces or compartments, as in airplanes, personal inspection is not always possible in flight, and, as a result, the pilot or observer is unable to determine when the fire has been extinguished.

Also, with such systems, false alarms are sometimes transmitted due to the present of dust in the detector tube, or due to some electrical disturbance or other cause. When, therefore, an alarm is transmitted, the pilot or observer cannot determine whether it is a false alarm or it is due to the outbreak of fire; hence fire extinguishing medium is released into the space or compartment by the pilot or observer, resulting, in the case of a false alarm, in the wasting of fire extinguishing medium and unnecessary concern and confusion.

Accordingly, it is one of the objects of the present invention to provide an improved detecting apparatus, whereby upon receiving a fire alarm, the pilot or observer can readily determine whether the alarm is the result of a fire or is a false alarm.

Another object of the invention resides in the provision of detecting apparatus wherein, after fire extinguishing medium is discharged into the protected compartment or space, the pilot or observer can readily determine, without a personal inspection of the compartment, whether the fire has been extinguished or is still in progress.

Another object resides in the provision of readily operable means for determining the density or concentration of smoke in the compartment, as well as any increase or decrease in such concentration.

Other and further objects of the present invention will be obvious from the following specification and the accompanying drawing, wherein preferred embodiments of the invention are described and illustrated.

In the drawing:

Figure 1 is a diagrammatic illustration of the invention applied to a detector tube of the single photoelectric cell type.

Figure 2 is a similar illustration of the invention applied to a balanced photoelectric cell type detector; and

Figures 3 and 4 are diagrammatic illustrations of modified forms of the invention.

Referring to the drawing in detail, a detector tube 10 is shown having a detector lamp 12, constituting a light source, mounted in one end of the tube and connected to a source of current supply 14. A lens 16 is also mounted adjacent the light source, and a photoelectric cell 18 is mounted in the opposite end of the tube in the path of direct rays of light from the detector lamp. The tube has an air inlet 20 and an air outlet 22. A suction device or blower 24 is provided for drawing air from a protected space or compartment, which is in communication with the inlet and thence through the tube from the inlet to the outlet.

When smoke is present in the air drawn through the detector tube, and consequently into the path of the rays of light falling on the photoelectric cell, the intensity of the light rays is reduced, thereby resulting in a reduction of the current flowing in the photoelectric cell circuit.

A relay 26, connected in the photoelectric cell circuit, has a pointer or switch arm 28, which is in balanced position while a normal current is flowing in the photoelectric cell circuit. When the current output of the photoelectric cell falls to a predetermined value below normal, the arm 28 moves to the right, as viewed in Figure 1, into engagement with a contact 30. An alarm circuit is connected to the relay, so that when the arm 28 engages the contact 30 the alarm circuit is established from a source of current supply, such as a battery 32, through the relay to an alarm 34. The relay 26 is preset to close the alarm circuit upon a predetermined drop in the current output of the photoelectric cell, and accordingly cannot give graduated readings beyond the preset point.

A manually operable switch 36 is provided in line 38 of the photoelectric cell circuit, whereby the relay 26 may be disconnected from the photoelectric cell circuit and a smoke density indicating meter 40 of sufficient range shunted into the circuit when the switch 36 is moved out of engagement with the contact 42 and into engagement with a contact 44.

The switch 36 may be a push button or switch lever conveniently located on the instrument panel of the airplane within easy reach of the pilot or observer, so that, when an alarm is given, the pilot or observer may press the button or throw the lever to disconnect the relay 26 from the photoelectric cell circuit, interrupt the alarm circuit, and connect the smoke density meter into the photoelectric cell circuit.

The smoke density indicating meter has the usual pointer 41 and a relatively long scale 43, so that when it is connected into the photoelectric circuit, in the manner just described, the pilot or observer can readily determine the density of the smoke in the smoke detector tube and observe changes in the density or concentration of the smoke, whereby to determine the condition of the fire. Should the meter show an increasing smoke concentration, it will be an indication that the fire is still in progress, while a decreasing concentration will be an indication that the fire is subsiding. Should the meter show zero concentration, it will be an indication that the fire has been extinguished. If, after a reading showing zero concentration, the smoke density indicating meter should again show an increase in the concentration, it would be an indication that the fire has reignited. Should the meter reading remain static, it will be an indication that the alarm was a false alarm due to the presence of dust in the air or on the lens, detector lamp or photoelectric cell, or due to some electrical disturbance.

The illustration of Figure 2 is somewhat similar to that of Figure 1, except that it shows the present invention applied to a smoke detector of the balanced photoelectric cell type. The operation of the detector and indicating means of Figure 2 is the same as that of Figure 1 and the same reference numerals have been applied to corresponding parts in the two forms.

In the modification shown in Figure 3 the relay 26 and the smoke density indicating meter 40 are connected in series in the photoelectric cell circuit. In this form, when no smoke is present in the detector tube 10, the arm 28 of the relay and the pointer 41 of the meter are in the positions illustrated. When smoke is drawn into the tube 10 and the current generated by the photoelectric cell drops to a predetermined value, the contact arm 28 of the relay 26 will move into engagement with the contact 30 thereof whereby to close the alarm circuit, and at the same time the pointer 41 of the meter will move across the scale 43 whereby to indicate the degree of density of the smoke in the tube 10. The observer can readily determine from the action of the pointer 41 whether the alarm is true or false, and if true, he can readily observe the condition of the fire, as determined by the indicated changes in the density.

In the modification shown in Figure 4, a single relay or meter 48 is illustrated, which serves the dual function of the relay 26 and the indicating density meter 40 of Figures 1 and 2. In this form the full scale of the meter is employed. The relay has a plurality of shunt resistors, in series with a normally open switch, connected across its coil, each having a resistance which is a multiple of the resistance of the relay coil. By way of example, the shunt resistor 50, when connected across the coil may have a resistance the multiple of two so that when it is connected across the coil it doubles the range of the relay, the shunt resistor 52 may have a resistance the multiple of three so that it will triple the range of the relay when connected across the coil, and the shunt resistor 54 may have a resistance the multiple of four, so that it will quadruple the range of the relay. Any desired number of resistances may be employed, each being adapted to be manually selectively connected into the relay circuit, by merely closing a switch 56 of the selected shunt resistor, after a signal is given by reason of the arm 28 engaging the contact 30, in the manner described in connection with the other forms. When the proper resistance is cut into the circuit to effect the return of the contact arm 28 or the separation of that arm from the contact 30, that arm will thereafter operate, in the same manner as the meter 40, to indicate the density of the smoke in the detector tube 10.

It is well known that smoke detectors are adversely affected by voltage variations, and it has been the practice to provide a voltage regulator or equivalent compensator to accommodate the detector to such variations. It is to be understood that the detector of the present invention may be provided with such a regulator or compensator, inasmuch as the provision thereof does not constitute part of the present invention. Also, it is to be understood that a conventional ampli-

fier may be provided in the photoelectric cell circuit.

From the foregoing it will be seen that the present invention provides a detector wherein the progress or retardation of fire in a protected space or compartment can be observed from a point remote from the space or compartment, and wherein false fire alarms can readily be detected.

While I have illustrated and described preferred embodiments of my invention, it is to be understood that I do not wish to be limited to the precise structure and arrangement of parts as described and illustrated, as obviously various changes and modifications may be made therein without departing from the spirit and scope of my invention.

I claim:

1. In smoke detecting apparatus of the class described, the combination of a source of light, an electric circuit therefor, a second electric circuit, means responsive to variations in the intensity of the rays of light from said source to effect changes in the current flowing in said second circuit, means for interposing a stream of air in which smoke is to be detected in the path of said light rays to effect variations in the intensity thereof, electroresponsive means in said second circuit operable upon the presence of smoke in the path of said rays, signal means, a circuit for said signal means including switch means operable by said electroresponsive means adapted to be closed to operate the signal means upon the operation of said electroresponsive means, a smoke density indicator in paid second circuit and means operable to render said electroresponsive means ineffective and said indicator operable to effect an indication of the density of the smoke and changes therein.

2. In smoke detecting apparatus of the class described, the combination of a source of light, an electric circuit therefor, a second electric circuit, means responsive to variations in the intensity of the rays of light from said source to effect changes in the current flowing in said second circuit, means for interposing a stream of air in which smoke is to be detected in the path of said light rays to effect variations in the intensity thereof, electroresponsive means in said second circuit operable upon the presence of smoke in the path of said rays, signal means, a circuit for said signal means including switch means operable by said electroresponsive means adapted to be closed to operate the signal means upon the operation of said electroresponsive means, a smoke density indicator in said second circuit, and manually operable switch means in second circuit to render said electroresponsive means ineffective and said indicator operable to effect an indication of the density of the smoke and changes therein.

3. In smoke detecting apparatus of the class described, the combination of a source of light, a circuit, means responsive to rays of light from said source to generate electric current in said circuit, means for interposing a stream of air in which smoke is to be detected in the path of said rays, a relay connected in said circuit operable upon the presence of smoke in the path of said rays, signal means, a circuit for said signal means adapted to be closed to operate the signal means upon the operation of said relay, a smoke density meter, and means operable to disconnect said relay from said first mentioned circuit and connect the smoke density meter into the circuit, whereby to indicate the density of the smoke and changes therein.

4. In smoke detecting apparatus of the class described, the combination of a source of light, a circuit, means responsive to rays of light from said source to generate electric current in said circuit, means for interposing a stream of air in which smoke is to be detected in the path of said rays, a relay connected in said circuit operable upon the presence of smoke in the path of said rays, signal means, a circuit for said signal means adapted to be closed to operate the signal means upon the operation of said relay, a smoke density meter, and manually operable means for disconnecting said relay from said first mentioned circuit and connecting the smoke density meter into that circuit, whereby to indicate the density of the smoke and changes therein.

5. In smoke detecting apparatus of the class described, the combination of a source of light, a circuit, means responsive to rays of light from said source to generate electric current in said circuit, means for interposing a stream of air in which smoke is to be detected in the path of said rays, a relay connected in said circuit operable upon the presence of smoke in the path of said rays and having a switch arm and a contact in the path of said arm, signal means, a circuit for said signal means including said switch arm and contact adapted to be closed to operate the signal means upon the operation of said relay, a smoke density meter, and manually operable means for disconnecting said relay from said first mentioned circuit and connecting the smoke density meter into that circuit, whereby to indicate the density of the smoke and changes therein.

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